mounted thereon. The second cover 19 has the inlet 20 at one edge surface thereof, from which air is taken in by the rotation of the fan 17 and is blown out from the outlet 14 while passing among the fins 15 to carry off heat therefrom. The second cover 19 can be mounted on the heat sink substrate 12 such that the inlet 20 is directed in a predetermined direction, thereby realizing a heat sink which takes in air from a predetermined direction and vents the air in a predetermined direction. Thus, in case that it is necessary to cool parts emitting large amounts of heat inside a device equipped with the heat sink, it is possible to take in air from an optimal direction, thereby enabling the optimization of the effect of cooling the entire casing containing an MPU and the like. In addition, the structure 21 provided in the casing of a notebook-type personal computer etc. for regulating a space above the heat sink can sufficiently secure the inflow route of air even if it is in contact with the upper surface of the second cover 19, thereby eliminating the variation of performance due to the space between the heat sink and the structure 21 to facilitate designing the device.

It is possible to mount the second cover 19 on the heat sink substrate and take in air from a direction also in the conventional structure, but the thickness of the heat sink substrate increases by that of the second cover 19. In case that the second cover 19 is mounted on the heat sink according to the second embodiment of the present invention, it is possible to arrange the motor 16 and the second cover 19 closely to each other, thereby realizing a thin heat sink capable of taking in air from a particular direction and venting the air in one direction. Devices requiring the one-direction air taking and the one-direction air venting are mainly thin devices limited in space, so that the thin one-direction air taking and one-direction air venting heat sink having the structure of the present invention can realize a large effect.

Now, a third embodiment will be described. FIG. 6 is a perspective view of a heat sink according to the third embodiment of the present invention, and FIG. 7 is a view showing the inside of an electronic device in which a heat sink according to the third embodiment of the present invention is incorporated.

Reference numeral 60 designates a heat emitting element, 61 is a heat sink similar to that of the second embodiment, 62 is an inlet provided in the heat sink 61 for taking in air, 63 designates an outlet provided in the heat sink 61 for venting air therefrom, 64 is a first duct connected to the inlet 62, and 65 is a second duct connected to the outlet 63. Although the figure illustrates the first duct 64 and the second duct 65 each having a rectangular cross section similar to that of the inlet 62 or that of the outlet 63, they can have any shape; for example, it is also possible that the tip end of the first duct 64 at the side of taking in air has a shape laterally wider than the inlet 62 and the tip end of the second duct 65 at the side of venting air has a shape of a circle or the like larger than the outlet 63. Alternatively, the duct can be provided only at either of the inlet 62 or the outlet 63. In FIG. 7, reference numeral 70 designates the casing of an electronic device, 71 is a printed board on which electronic parts, heat emitting elements etc. are arranged to constitute an electric circuit, and 72 is a heat emitting device such as a power supply. The first duct 64 at the side of the inlet 62 has its opening in the vicinity of the heat emitting element 72 such as the power supply inside the electronic device, while the second duct 65 at the side of the outlet 63 has its opening at the exhaust port of the casing 70 of the electronic device. Air flow generated by the heat sink 61 takes in air around the heat emitting element 72 through the first duct 64, passes through the heat sink 61 and is vented from the casing of the electronic device through the second duct 65.

The operation of the heat sink having the above structure according to the third embodiment will be described with reference to FIGS. 6 and 7.

As shown in FIG. 7, providing the first duct 64 and the second duct 65 in the heat sink enables taking in air at a predetermined position from a predetermined direction and venting the air to a predetermined position in a predetermined direction, thereby eliminating the restriction in the direction and position in taking in and venting air caused by the position of the MPU or that of the printed board. Without the first duct 64 at the inlet side, the heat sink 61 only takes in air on the printed board 71, but providing the opening of the first duct 64 in the vicinity of a specific component, for example, the power supply 72, enables taking air as well as cooling the power supply 72. In addition, providing the opening of the second duct 65 at the exhaust port of the casing 70 enables discharging the heat of the heat emitting element 60 or that of the power supply 72 from the casing with certainty, thereby preventing the heat from diffusing therein. It is also possible to eliminate the necessity of additionally providing a fan for exhausting air other than the heat sink in the casing, thereby simplifying the structure.

The present invention can be embodied in other various forms without departing from the spirit or main features thereof. Therefore, the preferred embodiments set forth above are illustrated only by way of examples in all respects, and should not be interpreted by way of limitation. The scope of the present invention is represented by the scope of the claims for a patent but not restrained by the specification at all. Furthermore, the modifications or variations belonging to the equivalent of the scope of the claims for a patent are all within the scope of the present invention.

What is claimed is:

1. A heat sink comprising:

a substrate having a floor and a vertical side wall open in one direction;

a plurality of fins vertically projecting from said floor of said substrate;

driving means at least a part of which is supported by said floor of said substrate; and

a fan rotated by said driving means wherein:

a height of an upper surface of said side wall is lower than that of an upper surface of said driving means relative to said floor of said substrate.

2. A heat sink according to claim 1, characterized in that the fan has a shape of an axial fan.

3. A heat sink according claim 1, wherein said driving means has a housing and said height of said upper surface of said side wall is lower than the height of an upper surface of said housing of said driving means relative to said floor of said substrate.

4. A heat sink comprising:

a substrate having a floor and a vertical side wall open in one direction;

a plurality of fins vertically projecting from said floor of said substrate;

driving means at least a part of which is supported by said substrate;

a fan rotated by said driving means; and

a plate mounted on an upper surface of said side wall and having an opening, wherein:

a height of said upper surface of said side wall and a height of an upper surface of said plate are lower

than that of an upper surface of said driving means relative to said floor of said substrate.

5. A heat sink according to claim 3, characterized in that the opening of the plate is so large as to allow the driving means to penetrate the plate through said opening but smaller in diameter than the fan.

6. A heat sink according to claim 5, characterized in that the fan has a shape of an axial fan.

7. A heat sink according to claim 4, characterized in that the fan has a shape of an axial fan.

8. A heat sink comprising:

a substrate having a floor;

a plurality of fins vertically projecting from said floor of said substrate;

driving means at least a part of which is supported by said substrate;

a fan rotated by said driving means;

a plate having an opening; and

a vertical side wall structure disposed between said substrate and said plate, said vertical side wall structure being open in one direction, said plate being positioned at an upper surface of said side wall structure, said plate and said side wall structure forming a frame having a height which is lower than a height of an upper surface of said driving means relative to said floor of said substrate.

9. A heat sink according to claim 8, wherein said opening of said plate is sufficiently large to allow said driving means to penetrate said plate but smaller in diameter than said fan.

10. A heat sink according to claim 8, wherein said fan has the shape of an axial fan.

11. A heat sink according to claim 9, wherein said fan has the shape of an axial fan.

* * * * *

12. A heat sink apparatus comprising:
a heat sink apparatus substrate for being attached to a beat emitting element, and having a bottom portion with a standing wall mounted thereon;
a driving device supported by said substrate;
an axial fan mounted on said driving device;
a plurality of fins provided in said housing, said fins being provided substantially in parallel to an air flow direction at an end portion of said standing wall; and
a cover mounted on said standing wall, wherein said driving device protrudes through an opening formed on said cover and a height of an upper surface of said fan and a height of an upper surface of said cover are lower than that of an upper surface of said driving device relative to said bottom wall.

13. A heat sink apparatus comprising:
a heat sink apparatus substrate for being attached to a heat emitting element, and having a bottom portion with a standing wall mounted thereon, said standing wall defining an air outlet,
a driving device supported by said substrate;
an axial fan mounted on said driving device;
a plurality of fins provided in said housing, said fins being provided substantially in parallel to said standing wall at said air outlet; and
a cover mounted on said standing wall, wherein said driving device protrudes through an opening formed on said cover and a height of an upper surface of said fan and a height of an upper surface of said cover are lower than that of an upper surface of said driving device relative to said bottom wall.